Dense and porous calcium phosphate scaffolds and their biological evaluation

R. Ramachandra Rao[1 *], Biswanath Kundu[2], Manjusha Chakraborty[3], L. Mariappan[1] and H. N. Roopa[1]

1 Materials Science Division, CSIR-NAL, Bangalore 560017
2 Bioceramics and Coating Division, CSIR-CGCRI, Kolkata 700032
3 Cancer Biology and Inflammatory Disorder Division, CSIR-IICB, Kolkata 700032
* Corresponding author; Email: rrrao@nal.res.in, Phone: +91-9449087753

Abstract

This paper discusses the studies carried out on preparing the dense and porous scaffolds from commercial tricalcium phosphate (TCP) and hydroxyapatite (HAp) powders through gel casting and mouldless casting route. Gel casting of TCP using different percentages of foaming agent produced shapes having porosities in the range of 13 to 27%, densities in the range of 72 to 82% and 3-point flexural strength of 10 to 22 MPa. The samples have micro porosity in the range of 1-5 μm and macro porosity in the range of 50 to > 130 μm. Dense HAp samples produced by gel casting show density of 99 ± 0.5% and 3-point flexural strength of 64±10 MPa. Scaffolds having three dimensional channeled, interconnected, porosity, were produced from both TCP and HAp by a novel shaping method of mouldless casting. The samples have filament thickness in the range of 350 to 550 μm and channeled pore width in the range of 400 to 900 μm. The samples had microporosities in the range of 0.1-2 μm. Both gel cast and mouldless cast scaffolds of TCP and HAp were primarily studied for in vitro biocompatibility and toxicity studies using mesenchymal stem cells (MSCs) isolated from murine bone marrow and human umbilical cord blood. After enriching the MSCs using density gradient centrifugation, isolated MSCs were expanded ex vivo in presence of cytokines. Phenotype and functional characterization of MSCs were done by flow cytometry, colony forming cell assay and gene expression analysis. In toxicity assay, proliferation and differentiation of MSCs were confirmed by growing them in culture in contact with the scaffolds. The results of such analysis will be reported in the present paper.

KEY WORDS: CALCIUM PHOSPHATE, POROUS SCAFFOLD, BIOLOGICAL EVALUATION, TISSUE ENGINEERING

(a)  (b) 

Scaffold from (a) Tricalcium phosphate and (b) Hydroxyapatite